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# Study of Landscape Gardens: Expectations and Users' Perceptions of a High-Rise Office Building

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## Abstract

Amidst today's energy-economic crisis, the introduction of green spaces in a high-rise building is one way of reducing building's cooling load, which at present relies mainly on air conditioning. This paper evaluates users' perceptions and expectations in three different landscape gardens on a 21-storey high-rise office building in Penang, Malaysia. The questionnaire focuses on comfort level, landscape preferences as well as expectations and use of space. The low usage factor was attributed to the unawareness of the gardens' existence, low accessibility and users' preference of staying indoors. The three gardens are significantly different in its overall comfort level, thermal comfort parameters, attractions and number of visits.

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*Keywords* : Energy-economic crisis; users' perceptions; landscape gardens; landscape preferences

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## 1. Introduction

Rapid urbanization and population growth lead to the increase of high-rise buildings in cities. This marks in shortage of green spaces in urban areas that causes alarming rate of environmental issues such as Urban Heat Island (UHI) effect. This scenario is becoming a trend in Asian countries such as Singapore,

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Tokyo and Hong Kong where more buildings are growing vertically in commercial and residential development. Outdoor green spaces are known to contribute to the quality of life in the overpopulated cities. Loss of green areas due to the scarcity of land in urban areas has resulted in the creation of landscape in high-rise buildings. Antrop (2000) described that in the second half of the 20th century, rapid changes in landscape has increased in an unprecedented manner. Over the last couple of decades, landscapes have been valued in many different ways. The purpose of a garden can be for its aesthetic, ecological, environmental and economic values. The value of landscape is no longer anticipated for human survival alone, but has evolved towards achieving an ecological balance in the environment. Nur Huzeima and Byrd (2012) emphasized the theory by Ian McHarg that is applicable in an urban living lifestyle today. In addition, global environmental issues have increased the risk of unpredictable weather issues, which affects local activity and spatial planning usage in landscape spaces. This paper focuses on the landscape of a high-rise office building, where exposure to nature is limited.

## 2. Theoretical review

Outdoor green spaces in high-rise buildings allow passive approach of green design by the means of natural ventilation. These gardens are often designed in the form of sky court, balcony, rooftop, and terrace with paving, seating, and deep layers of substrates for garden landscaping. In outdoor climate, the use of open space is consequently affected by people's perception of how they perceived the space. People's perceptions towards thermal comfort of theirs' surrounding often influence their behavior. This is crucial for outdoor conditions in hot and humid countries such as Malaysia. In general, the temperature ranges from 29°C to 35°C during the day while the humidity level from 70% to 90%. The study area, situated in Penang Island, located on the northwest coast of Peninsular Malaysia experiences 1-2 °C higher temperature compared to the mainland. Combined with the high humidity level, it is often uncomfortable to stay outdoors during the day. Nikolopoulou and Steemers (2003) concluded that people's perceptions are influenced by microclimate factors; in particular air temperature, humidity, wind speed and radiation fluxes (solar radiation), and by a set of personal parameters, such as physical activity, level of clothing and age, and also psychological factors, namely motivation, individual preferences and cultural aspects. Therefore, it is also important to examine the microclimate conditions so that the place is thermally comfortable for the users in outdoor landscape. Thermal comfort is defined by ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning) as "the condition of mind which satisfaction is expressed with the thermal environment". The standards of ASHRAE 55-92 specified that the thermal acceptability should be defined as the condition where 80% of occupants vote for the central three categories (slightly cool, neutral, slightly warm). Achieving thermal comfort in high rise buildings is more challenging compared to low-rise buildings where the latter is often shaded by adjacent trees and buildings nearby.

In areas of high density development, landscape spaces in high-rise office buildings offer a psychological retreat space for occupiers to relax their mind from work stress. Work stress issues are often associated with the condition of the workplace. Office workplace is a setting where a person spends one-third of their time daily, which is equivalent to more than 8 hours. Research shows that workstation environments that were characterized by extreme heat, dim lighting, and congested work area can be associated to stress at workplace (Sutton and Rafaeli, 1987). A conducive workplace with good exposure to nature gives restorative effects and improves individual psychology well-being at work. Kaplans' study on natural experiences found that everyday places such as gardens and backyards, as having virtually as much restorative power as nature itself (Krinke, 2005). Studies have also shown that there is statistically significant relationship between access to a garden at the workplace and the number of stress occasions experienced a year. (Stigdotter, 2004b). In addition, a constant access to a view of a verdant garden is just

as important as being able to spend time in a garden a few times a week. Outdoor green spaces allow occupants on higher floors to reconnect with the natural environment during the long and stressful hours at work. However, past studies have shown that the failure in designing such spaces will result in non-usage and underutilization. This is fundamental as the outdoor landscape design in a tropical climate can have an effect on the microclimate.

This paper will address users' perceptions and their preferences towards landscape provision in high-rise office buildings. While there is increasing awareness to sustainable building approach, there is relatively limited discussion on the psychological aspects of people's need and preference as most research focuses on the empirical studies of thermal comfort. Mohamed Ikhwan Nasir and Saruwono (2012) concluded in their study that the synergy between landscape architects and users would make the process of creating public parks a truly holistic approach. The benefits of public participation allow users to provide feedbacks and ideas to professional designers, whom contribute technical expertise and analytical knowledge in designing a park. User's perceptions of thermal comfort in landscape gardens are important in determining occupants' comfort level as well as psychological needs in outdoor areas.

### **3. Methodology**

The study focuses on a high-rise office building situated in an urban area in Penang, Malaysia. The building, known as Suntech, was chosen as a case study as it is the only high-rise office buildings in Penang, Malaysia that showcase different types of landscape gardens: Sky Court Garden, Balcony Garden and Rooftop Garden in a building. A questionnaire survey was carried out in a 21-storey commercial high-rise office building. The gardens vary in size, design, floor level, height of the space, landscape features and facilities provided but are similar in orientation (all locations is facing towards east). The respondents' perceptions towards three different typologies of gardens were analyzed further.

The population of this study was drawn from the building occupants of Suntech building. The questionnaire survey involved a study of respondents from 60 companies occupying the office space in the building. The smallest company involved 3 workers while the largest has more than 200 staff. A 10% sample from each company was selected as respondents. A simple random sampling was used to select the respondents from the sampling frame. Five out of the total 60 companies were excluded from the study as they declined to participate in the survey. A total of 102 successful questionnaire interviews were completed yielding a respond rate of 48%. The questionnaire survey covered demographic information, users' perceptions of thermal comfort, preferences of landscape features and a section on the provision of landscape gardens in high-rise buildings.

#### *3.1. Sky Court Garden*

This landscape area is located on the 10th floor of the Suntech Building, where it can be seen from the main lift lobby area as it is partitioned by a glass wall. It comprises of a gymnasium and a cafeteria, located within a landscape setting. This area is made public as most activities and events are held here. The garden features a water cascade and a separate fishpond as well as plantings in the form of shrubs, flowers, potted plants and some palms. It is a double volume space with large openings covering a floor area of 213.5 m<sup>2</sup>.

#### *3.2. Balcony Garden*

This landscape garden is located on the 12th floor of Suntech building. It is a double volume space with a narrow plan form, covering a floor area of 67.65 m<sup>2</sup>. The garden is secluded to its non-central

location. It has a mixture of vegetation planted in a concrete planter box along length of the garden. Two sets of tables and seats were provided for outdoor dining and discussion. The area is enclosed within three walls and it does not allow for cross ventilation.

### 3.3. Rooftop Garden

This landscape area is located on the rooftop of the Suntech building (21st floor). The openness of the area differentiates it from the Sky Court Garden and Balcony Garden. The floor area is 380 m<sup>2</sup>; the largest garden among the three. It is often unsuitable to conduct outdoor activities in the area due to its exposure to hot and humid tropical weather. Landscape elements include potted plants, shrubs and plants in planter boxes. Seating areas are also provided for users of the garden.

## 4. Result and discussion

### 4.1. Demographic factors

Table 1 shows that the respondent's distribution according to gender is almost equal. Forty six percent of respondents were male and 53.9% were female. The age of respondents varied between 21 and 60 years old. Majority of the respondents were between 21 years to 35 years old (88.2%). The ethnic distribution showed that the respondents were predominantly Chinese (72%), followed by Indian (17%) and Malay (11%). An analysis of the education background showed that majority of the respondents has a university degree (54%) while about 10% are Master or PhD holder. This is followed by diploma holders (22%) and 15% of the respondents finished basic education (O level). In terms of job designation, most of the workers were administrative staff (27%) followed by executives (14%), managerial staff (12%), and professionals and technical support staff both made up 11% of the respondents respectively. The majority of the respondents have worked in the building between a month to a year (46%) while 14.7% of the respondents have accounted for those who have worked less than a month.

### 4.2. Level of usage

The findings indicate moderate usage of gardens. Only 52.6% of respondent have visited the landscape gardens although 96% of the respondents supported the provision of such spaces in high-rise office buildings. A gap seems to exist between respondents awareness and usage of gardens suggesting for a closer analysis of occupant's needs to avoid an important overlooked phenomenon in urban park provision: non-use. This relates back to the first principle of landscape planning: open space that do not meet people's need or serve no important function for people are destined to be underutilized and by their use criterion, unsuccessful (Burgess *et al.*, 1988). Factors of low usage of gardens were reported in the literature reviews include demographic characteristics, comfort level, distant from landscape gardens to workplace location, and respondent's preference and perception towards landscape gardens.

Table 1. Descriptive of demographic characters

Variable	Description	Frequency	Percentage (%)
Gender	Male	47	46.1
	Female	55	53.9
Age group	21-35	90	88.2
	36-40	6	5.9
	41-50	5	4.9
	51-60	1	1.0
Ethnicity	Malay	11	10.9
	Chinese	73	72.3
	Indian and others	17	16.8
Level of education	SPM	15	14.7
	Diploma	22	21.6
	Degree	55	53.9
	Masters/ Phd	10	9.8

The survey indicated that there is a significant difference in visitation of the three gardens ( $\chi^2 = 73.64$ ,  $df = 2$ ,  $p < .01$ ). The findings reveals that the majority of respondents have visited the Sky Court Garden (55.3%) while only 22.4% of respondents have visited the Balcony Garden and the Rooftop Garden respectively. For those who have not visited the sky court garden, 31% responded that they did not know that the garden existed. The same reason was given by the majority of those who have not visited the Balcony Garden (83%,  $n = 55$ ). In addition, the lack of accessibility (10%) was the second most mentioned reason for not visiting the Balcony Garden. For the Rooftop Garden, the lack of knowledge on the existence of the Rooftop Garden was cited by 38% of the respondents as the main reason for not visiting the garden. Poor accessibility was the second most frequent answer (29%) followed by preference for staying indoors (21%). The layout of the building shows that the Sky Court Garden is more accessible and more welcoming compared to the Balcony Garden and Rooftop Garden. The location of the Balcony Garden and Rooftop Garden are secluded and further away from the main lift lobby. This is similar with a study conducted in a high-rise residential building in Choa Chu Kang, Singapore by Yuen and Wong (2005). In that study, low utilization of park was caused by access and visibility. Unlike the ground level parks, access to the roof garden in the study site is at present through staircases only. This demands a certain level of physical fitness and local knowledge of these locations of the staircases. These findings also supported earlier statement by Alexander et al. (1977) that people will visit urban greenery on a regular basis if it is within 3-5min walk of their home/ workplace.

Pattern of usage across demographic characteristics were analyzed to see if it influences visits to gardens. Variables that were analyzed include age, gender, education background, ethnicity, job description and also location of their workspace in relation to the distance from the gardens. Findings have indicated that none of these demographic characteristics have significant relationship with visitation. This is similar with findings by Stigdotter and Grahn (2004b) who found access to a garden at work is not associated with gender, age and socioeconomic status. However, this is in contrast with previous studies on demographic factors across usage of gardens. Oliveira and Andrade (2007) found that a set of

psychological differences, depending mostly on ages can be found exists in regards to perception of environmental conditions. This is supported by Kalkstein (1997) who reported that elderly people are in general more susceptible to heat, whereas Penwarden (1973) stated that high wind speeds may be more dangerous to elderly or infirm people than to fit and active ones. Gender differences in relation to this have shown that females are more sensitive to heat stress compared to male (Parsson, 2002). Perceptions of comfort also can be affected by individual background, mainly on places of birth and residences (Nikolopoulou and Stemmers, 2003). In addition, Vigotti et al. (2006) have found that people born in warmer areas exhibit higher tolerance to heat.

Number of visit was analyzed to see if it is influenced by the distant of workplace to the landscape gardens (Table 2). The findings show that there is significant relationship between location of workplace and number of visits ( $\chi^2 = 24.06$ ,  $df = 3$ ,  $p < .001$ ). The visit to landscape garden are influenced by the distant of the workplace to the gardens. This is supported by findings from Stigdotter and Grahn (2004a) that concludes the farther the park is from home, the fewer and shorter are park visits.

Table 2. Distance of location by visits

Location of workplace	Visit	Do not visit
Level 10- 11 <sup>th</sup>	9.3%	4.1%
Level 12 <sup>th</sup> - 15 <sup>th</sup>	49.7%	42.1%
Level 16 <sup>th</sup> – 20 <sup>th</sup>	23.0%	46.9%
Level 21 <sup>st</sup>	18.0%	6.9%

Stigdotter and Grahn (2004a) argued that the more often and longer a person visits urban green spaces, the less likely that the person is to suffer from stress. At the Sky Court Garden, the frequency of visit showed that 35% of respondents have visited at least once in a month while 29.5% of the respondents have visited at least once in a week. This is similar with the Balcony Garden where the majority respondents have visited at least once in a month (28.6%) and once in a week (28.6%). However, at the Rooftop Garden; the majority of the respondents only visited the Rooftop Garden only once in a year (32.6%) and 30.2% of the respondents visit only once in six months. In general, the frequency of visit at the Rooftop Garden is lower compared to the Sky Court Garden and the Balcony Garden. Usage of gardens depends largely on the comfort level of an outdoor space. The overall comfort of the respondents at the three landscape gardens were identified by asking respondents their perception of comfort level based on a 5-point Likert scale ranging from very uncomfortable, uncomfortable, slightly comfortable, comfortable, to very comfortable. Mostly respondents feel comfortable (53.9%) at the Sky Court Garden, slightly comfortable (16.7%) at the Balcony Garden and comfortable (22.5%) at the Rooftop Garden. In general, most of the respondent perceived the gardens as a comfortable space. Despite the fact that the rooftop garden is exposed to direct sunlight, very few of the respondents feel uncomfortable/very uncomfortable.

#### 4.3. Users' perceptions and preference towards landscape gardens

The purposes of visiting landscape gardens were examined in order to understand user's preferences towards landscape gardens. The respondents were asked according to 5-point Likert scale ranging from not relevant, least relevant, relevant, very relevant to most relevant. The findings show a similar pattern for the three landscape gardens (Figure 1). At the Sky Court Garden, most respondent use the space to rest (79.5%), to get fresh air (77.3%), to enjoy the company of others (70.4%), to go to the gym (64.8%)



and to enjoy the landscape (64.8%). Similarly, at the Balcony Garden, most respondent visit the space to rest (73.5%), to get fresh air (70.6%) and to chat (58.8%). The trend is repeated at the Rooftop Garden, where most respondent visit the space to get fresh air (81.4%), to enjoy the landscape (76.8%), to rest (72.1%) and to enjoy the company of others (69.8%). This can be seen clearly that although the design of the three landscape gardens vary from each other, people still use the gardens for the same purpose. Among the purpose of visiting gardens that have lower votes were 'to do work' and 'to have meal', which are not quite practical due to the comfort level and facilities provided. Another study conducted on high-rise residential buildings by Yuen and Wong (2005) found that; respondents who lives away from the gardens roof ranks high on the purpose of visiting a garden: *to find peace and quite*. As for those who lived near the gardens, 'to get some exercise' presented the purpose for visiting roof garden. Respondents become attracted to the affordance of opportunities for physical activity and usage of facility provided. In this context, roof garden is a place to go rather than a place to get away from. The close proximity of facility makes it convenient for those living near roof gardens. It is seen as a place for recreation, as well as a setting for social and physical activity.

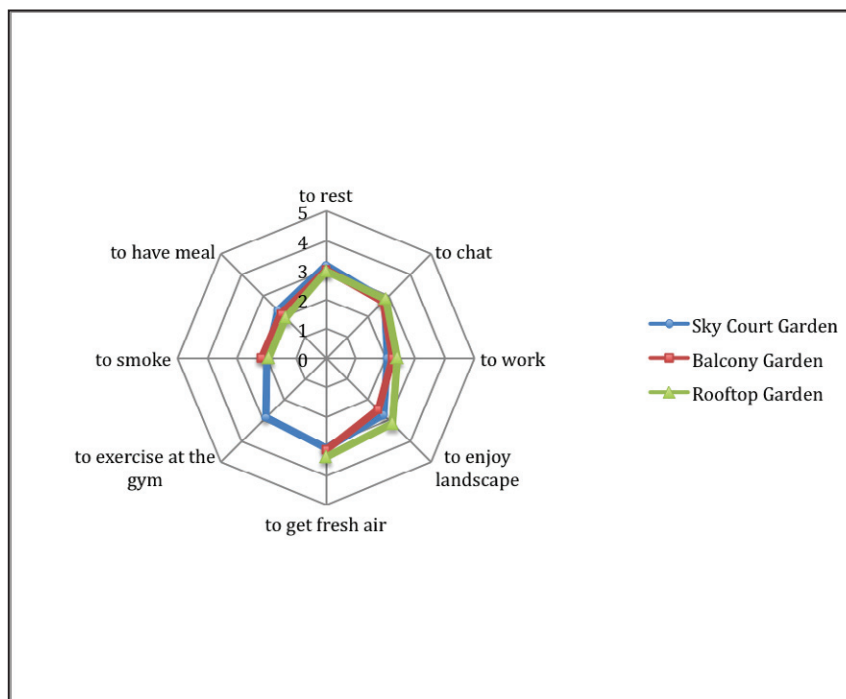


Fig. 1. Purpose of visiting landscape gardens

An analysis of general perception of respondents towards the provision of gardens in high-rise office space shows an overwhelming support from building's occupants. The majority of 96% respondents feel that garden should be incorporated in an office building. Their preference towards landscape gardens were further analyzed based on a 7-point Likert scale ranging from "totally agree to totally disagree" (Figure 2). Most respondents agreed that garden in an office building is a space to reduce stress (86.9%). Majority of the respondents also agreed that garden in an office building improves mood for work (78.8%). When respondents were asked if they generate a lot of new and creative ideas while being in the garden, 55.6% of the respondents agreed. It was reported that 65.7% of the respondents feel that garden

is a therapeutic place to be in. In addition, 75.8% of the respondents agreed that nature sound of wind breeze/ cascading water/ bird's chirping in an office building give a pleasant feeling. 66.7% of the respondents disagree with garden in an office building is a waste of money as people do not use the space. However, 41.4% of the respondents also feel that garden in an office building involves a lot of maintenance cost.

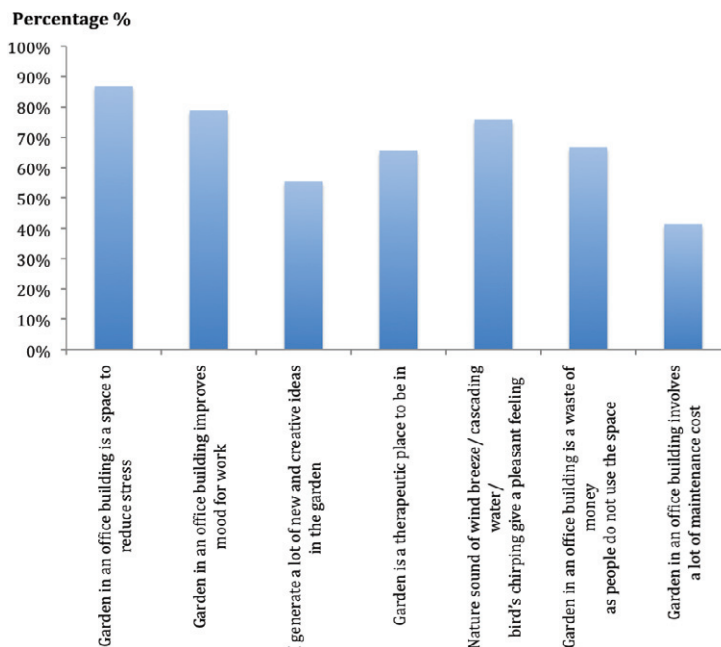


Fig. 2. Users' Preferences of landscape gardens

It is important to understand the needs and preference of respondents as to guarantee usage of gardens. A study by Larsen *et al* (1998) agreed that attractive settings positively increased participants' well-being ratings and that the presence of indoor plants increases the comfort and attractiveness of office environments. The respondents were asked to give suggestions and recommendation to improve the garden as to increase the number of visit at each of the gardens. The emphasis is on the awareness the existence of gardens and place usage. Fifty percents of the respondents who did not visit the Sky Court Garden recommended that the management to introduce and promote the existing gardens as many do not know of its existence. Twenty five percent of the respondents requested that more facilities to be provided such as gym equipments, tables and chairs and vending machines. At the Balcony Garden, 58.3% of the respondents also recommended to put up more signage to promote the existence of the garden. This is followed by 16.7% of the respondents suggesting a bigger space to be provided at this garden. The size of the Balcony Garden is smaller (67.65 m<sup>2</sup>) compared to the Sky Court Garden (213.5 m<sup>2</sup>) and the Rooftop Garden (380 m<sup>2</sup>). A few respondents also added that the layout can also be improved by proper arrangements of the plantings as to allow better views outside. Some also mentioned of the noise from the air conditioning compressor that they find quite disturbing in the area. At the Rooftop Garden, similar comments were raised by most respondents accounted for 54.5% to promote the existence of the garden by distributing flyers and putting up signboard. Twenty seven percent of the respondents suggest more attractions to the gardens. They suggested using the Rooftop Garden for more activities such as coffee



area and also a space for exercise routine such as swimming pool. In addition, the respondents also suggest more comfortable seats and tables to replace the current aluminium benches, which may not be practical especially under the hot sun. Some respondents also suggest the seating areas to be covered or shaded to protect and provide comfort for the users.

## 5. Conclusion

This paper describes the results obtained from a questionnaire survey of building's occupants of a high-rise building towards thermal comfort of landscape gardens. The findings show a significant difference between the three landscape gardens; namely the Sky Court Garden, the Balcony Garden and the Rooftop Garden in terms of numbers of visit. Low usage of landscape gardens was found to be influence by the lack of awareness on the gardens existence, poor accessibility and the lack of attractiveness in garden features. The number of visits to landscape gardens was not influenced by demographic characteristics of the respondents (age, gender, ethnicity, education level). However, the distant of the respondents' workplaces to landscape gardens have significant relationship with the number of visits. The respondents' perception and preference towards landscape gardens were then analyzed as to understand the users' preferences. It is critical to understand people's perception of landscape gardens as to achieve good design outcome that meet the requirements of users. Although the facilities provided and design of the landscape gardens vary from one another, user's still use the space for the same main purpose. The study reveals that usage of gardens are mostly to rest, to get fresh air, to enjoy the company of others as well as to enjoy the landscape provided. The next phase of the study, which is currently underway, focuses on fieldwork measurement of thermal comfort parameters (air temperature, humidity, wind velocity and solar radiation) at the three landscape spaces comparing between the wet and dry seasons in Malaysia. Thermal comfort parameters will be analyzed individually to find their contributing factors in influencing thermal comfort of the outdoor landscape areas. The role of vegetation in cooling the areas will be also examined. This study has several limitations. Firstly, the sample obtained from the respondents is small. This is partly due to the fact that the building has not been fully occupied. A more robust analysis requires a bigger sample size. Secondly, the perception study was conducted during the hottest period of the year (February – March) and therefore generalization can only be made in reference to those periods. The study found an overwhelming preference of garden provision in high-rise office environment. Future studies on evaluating psychological well-being should focus on assessing if landscape gardens in such settings help to reduce stress and improve work productivity.

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